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BUREAU OF MINES MINERALS YEARBOOK

The Mineral Industry of Australia

UNITED STATES DEPARTMENT OF THE INTERIOR

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This publication is a chapter from the current Bureau of Mines Minerals Yearbook, comprising *Volume I, Metals and Minerals; Volume II, Area Reports: Domestic; Volume III, Area Reports: International.* The separate volumes of the Yearbook are sold by the Superintendent of Documents, Washington, D.C. 20402.

The Mineral Industry of Australia

By Travis Q. Lyday[1]

The Australian minerals industry covered just about the whole spectrum of minerals, from major industrial minerals (ilmenite, rutile, and zircon), base metals (copper, lead, and zinc), ferrous metals (iron ore and manganese), nonferrous metals (aluminum and nickel), precious metals (gold and silver), fuel minerals (coal and uranium), to gem stones (diamond, opal, and sapphire). Australia was one of the world's principal producers and suppliers of ores, concentrates, and refined metals. The notable minerals, either missing from the Australian mining scene or produced in minor amounts, were fertilizer materials (phosphate rock and potassium fertilizer), chromium, and mercury. The minerals industry was the largest primary sector contributor, generating an estimated 10% of the country's gross domestic product (GDP).

Australia was the seventh largest producer of coal (all grades) in the world, ranking behind China, the United States, the U.S.S.R., the German Democratic Republic, Poland, and the Federal Republic of Germany and was the world's largest coal exporter. It was the largest producer of bauxite and alumina; ilmenite, rutile, and zircon; and diamond, opal, and sapphire. It was the second largest producer of iron ore, after Brazil, and the fifth largest gold producer, after the Republic of South Africa, the Soviet Union, the United States, and Canada. Australia was also a significant producer of copper, lead, tin, uranium, and zinc.

Australia has relied heavily on the export of the majority of its mineral production to bolster economic growth, as the country itself was too small a mineral consumer to use all of the minerals it produces.

Using plentiful resources of coal, liquefied petroleum gas, and uranium, Australia remained one of the few market economy countries to be a net exporter of mineral fuels, enabling the country to retain a favorable trade balance in energy products.

Government Policies and Programs.—The Government announced near yearend that export controls on primary copper, lead, manganese, nickel, and zinc would be removed as soon as the appropriate amendments could be made to the customs regulations. However, export controls will remain on copper scrap and copper-alloy scrap, secondary copper ingots, nickel powder, and, for environmental reasons, mineral sands.

PRODUCTION

The value of minerals produced in Australia in 1985, the latest year for which official data were available, was $15.4 billion,[2] almost 11% of the GDP. Petroleum (crude oil, natural gas, and natural gas liquids) contributed 45% of this total, followed by coal, 24%, and iron ore and concentrate, 9%. Other major contributors included construction materials, 4%; gold bullion, 4%; bauxite, 3%; copper, 2%; nickel, 2%; lead, 1%; uranium, 1%; and zinc, 1%. These were followed, in descending order, by lignite, manganese, salt, tin, rutile, ilmenite, diamond, zircon, opal, clays, limestone, silica, and tungsten.

The increase in the value of mineral products in 1985 was 28%, facilitated by the devaluation of the Australian dollar by

about 25% against major world currencies. The value of most major mineral commodities improved over the 1984 values, the largest increases being gold bullion, 65%; rutile, 60%; copper, 43%; petroleum, 35%; coal, 31%; nickel, 27%; iron ore, 22%; lignite, 21; construction materials, 17%; zinc, 12%; and lead, 7%. Uranium was the only major mineral to decrease markedly in value, falling 28%. Smaller decreases were recorded by limestone, tin, and gypsum.

Table 1.—Australia: Production of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1983	1984	1985	1986[p]	1987[e]
METALS					
Aluminum:					
Bauxite, gross weight thousand tons	24,372	r31,537	31,839	32,384	34,000
Alumina do.	r7,231	8,781	8,792	9,423	310,105
Metal, refined:					
Primary	478,190	757,798	851,286	881,910	21,003,947
Secondary	37,700	r43,300	34,100	r e55,000	355,000
Antimony, Sb content of antimony and lead concentrates	538	1,149	1,458	10,064	1,000
Bismuth, mine output, Bi content[e 3 4]	1,410	1,350	1,400	1,000	1,000
Cadmium:					
Mine output, Cd content	2,275	r2,311	2,776	2,260	2,500
Metal, smelter (refined)	1,121	1,082	1,060	870	3888
Cobalt:					
Mine output, analytic content of:					
Nickel ore	1,634	1,551	2,456	2,389	2,500
Nickel concentrate	477	520	508	e500	500
Zinc concentrate	85	54	72	41	50
Total	2,196	2,125	3,036	e2,930	3,050
Recoverable cobalt	1,100	936	1,134	r e1,400	1,450
Columbium-tantalum concentrate, gross weight	117	145	110	88	3159
Copper:					
Mine output, Cu content	261,476	235,671	259,765	249,368	223,000
Metal:					
Smelter:					
Primary	173,619	179,822	167,669	169,622	177,000
Secondary	8,202	9,138	7,687	e8,000	8,500
Refined:					
Primary	163,533	171,180	163,833	163,958	185,000
Secondary	27,388	r26,037	30,506	20,360	25,800
Gold:					
Mine output, Au content troy ounces	983,522	51,295,963	e1,881,491	2,413,842	3,472,000
Metal, refined:					
Primary do.	953,140	1,189,672	1,743,307	2,642,337	33,738,226
Secondary do.	96,774	85,746	e90,000	100,000	100,000
Iron and steel:					
Iron ore:					
Gross weight thousand tons	71,038	94,406	92,859	94,135	100,000
Fe content do.	45,298	r58,313	58,045	60,120	63,000
Metal:					
Pig iron do.	5,045	5,329	5,607	5,889	35,580
Ferroalloys:[7]					
Ferromanganese	53,463	70,883	70,368	61,000	352,000
Ferrosilicon	18,669	18,313	18,951	e15,000	19,000
Silicomanganese	19,810	31,795	25,669	e23,000	343,000
Total	91,942	120,991	114,988	e99,000	114,000
Steel, crude thousand tons	5,657	6,303	6,578	6,703	6,040
Semimanufactures[e]	5,500	6,000	6,000	6,250	6,000
Lead:					
Mine output, Pb content	480,626	440,620	497,954	447,673	476,000
Metal:					
Primary:					
Bullion, for export	182,593	179,491	183,161	188,403	3197,171
Refined	196,335	198,847	200,147	156,239	3201,317
Total	378,928	378,338	383,308	344,642	398,488
Secondary excluding remelt[e]	27,000	21,500	15,600	r14,800	15,600

See footnotes at end of table.

Table 1.—Australia: Production of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1983	1984	1985	1986[p]	1987[e]
METALS —Continued					
Manganese ore (metallurgical):					
Gross weight thousand tons	1,370	1,849	2,003	1,649	[2]1,853
Mn content do.	684	879	958	785	884
Nickel:					
Mine output, Ni content	76,625	76,923	85,757	76,739	74,500
Metal, smelter (refined Ni and Ni content of oxide)	41,800	38,660	40,807	42,097	[2]45,205
Platinum-group metals:[8]					
Palladium, Pd content troy ounces	[3]14,825	16,815	15,304	13,760	15,800
Platinum, Pt content do.	[3]1,759	2,122	3,054	3,697	4,209
Total do.	[3]16,584	18,937	18,358	17,457	20,009
Rare-earth metals, monazite concentrate:					
Gross weight	15,141	16,260	18,735	14,822	12,700
Monazite content	14,005	15,101	17,394	8,152	6,700
Silver:					
Mine output, Ag content thousand troy ounces	33,208	31,260	34,914	32,882	[2]32,762
Metal, refined do.	10,684	9,476	10,578	10,809	[2]9,948
Tin:					
Mine output, Sn content	[e]9,275	[e]7,939	6,363	8,508	7,500
Metal, refined:					
Primary	2,913	2,899	2,683	1,399	600
Secondary[e]	400	400	400	200	200
Titanium concentrates, gross weight:					
Ilmenite thousand tons	893	1,143	1,419	1,238	1,380
Leucoxene	13,358	32,110	13,809	14,143	12,200
Rutile	163,374	170,424	211,615	215,774	257,900
Tungsten, mine output, W content	2,015	[r]1,709	1,971	1,600	[2]1,150
Uranium, mine output, U content	3,211	4,324	3,206	4,154	[2]3,780
Zinc:					
Mine output, Zn content	699,032	676,532	759,083	662,258	733,000
Metal, smelter:					
Primary	298,451	301,940	288,686	305,654	[2]310,189
Secondary[e]	4,500	4,500	4,500	4,500	4,500
Zirconium concentrates, gross weight	382,005	457,599	501,440	451,824	439,000
INDUSTRIAL MINERALS					
Abrasives, natural:					
Beach pebble	[e]2,300	1,655	972	[e]2,000	2,500
Garnet (sales)	2,657	3,287	5,835	[e]3,500	5,000
Asbestos	3,909				
Barite	11,752	19,511	22,423	5,818	15,000
Cement, hydraulic thousand tons	4,836	5,463	5,887	5,870	6,000
Clays:					
Bentonite and bentonitic clay	30,026	39,172	29,070	24,942	25,000
Brick clay and shale thousand tons	6,203	7,898	8,434	[e]8,000	8,000
Cement clay and shale[10] do.	356	385	[e]400	[e]400	400
Damourite clay (sales)	93	2,164	[e]3,000	[e]2,000	2,000
Fire clay	[r]57,163	[3 10]82,686	[3]39,482	[e]60,000	60,000
Kaolin and ball clay	115,526	[10]218,885	165,827	[e]125,000	150,000
Other[10] thousand tons	2,502	1,847	1,750	[e]2,000	2,000
Diamond:					
Gem thousand carats	3,720	3,415	4,242	13,145	[2]13,650
Industrial do.	2,480	2,277	2,828	16,066	[2]16,683
Total do.	6,200	5,692	7,070	29,211	[2]30,333
Diatomite	7,921	6,430	7,587	7,860	8,000
Feldspar including nepheline syenite	4,244	3,898	6,704	10,456	11,000
Gem stones, other than diamond:					
Opal value, thousands	$40,035	$35,358	$32,305	$36,914	$43,500
Sapphire do.	$12,036	$7,846	$5,342	$8,359	$13,500
Other do.	$3,307	$3,196	$3,326	$2,316	$2,500
Total do.	$55,378	$46,400	$40,973	$47,589	$59,500
Gypsum thousand tons	1,510	1,931	1,744	1,569	1,600
Kyanite[11]	445	1,255	650	1,500	1,500
Lime[3]	1,016,361	1,101,000	1,203,000	[r]1,100,000	1,100,000
Magnesite	20,534	67,641	57,535	38,996	50,000

See footnotes at end of table.

Table 1.—Australia: Production of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1983	1984	1985	1986[p]	1987[e]
INDUSTRIAL MINERALS —Continued					
Nitrogen: N content of ammonia	385,000	375,600	404,500	340,000	[2]413,400
Perlite, crude	2,856	3,708	[r e]2,740	[e]3,000	3,500
Phosphate rock	4,868	15,345	33,116	33,659	[2]10,000
Salt thousand tons	5,170	5,695	5,835	[e]6,200	6,200
Sillimanite[12]	121	507	650	133	500
Sodium compounds, n.e.s.: Sodium carbonate[e] thousand tons	300	300	300	300	300
Spodumene, concentrate[3]	1,000	6,500	11,200	[e]11,000	16,000
Stone, sand and gravel:					
Construction sand[10] thousand tons	23,543	24,675	26,640	[e]25,000	25,000
Gravel[10] do.	13,931	15,031	18,393	[e]15,000	15,000
Dolomite do.	585	595	623	[e]600	600
Limestone:[e]					
For cement do.	8,500	9,000	10,000	10,000	10,000
For other uses do.	3,800	4,000	5,000	5,000	5,000
Silica in the form of quartz, quartzite, glass sand do.	1,928	2,242	2,091	[e]2,000	2,000
Other:					
Crushed and broken stone do.	49,115	56,331	67,474	[e]50,000	60,000
Dimension stone do.	97	[r]102	167	[e]100	150
Unspecified do.	25,869	[r]28,986	33,808	[e]25,000	30,000
Sulfur: Byproduct:					
Metallurgy	170,000	190,000	435,313	433,161	435,000
Petroleum	12,897	[r]13,058	11,718	10,200	[2]8,500
Total	182,897	[r]203,058	447,031	443,361	443,500
Talc, chlorite, pyrophyllite, steatite	176,578	186,760	139,391	188,040	175,000
MINERAL FUELS AND RELATED MATERIALS					
Coal:					
Bituminous and subbituminous thousand tons	120,482	139,094	158,256	170,031	175,500
Lignite do.	[r]34,120	[r]34,756	37,320	37,617	38,000
Total do.	[r]154,602	[r]173,850	195,576	207,648	213,500
Coke, metallurgical do.	3,374	3,606	3,610	3,523	3,500
Fuel briquets do.	772	810	789	833	1,000
Gas, natural, marketed million cubic feet	420,115	445,966	475,481	519,426	[2]530,543
Natural gas liquids thousand 42-gallon barrels	23,000	21,175	25,939	24,723	[2]24,426
Peat[13]	10,026	[r]14,010	15,707	5,550	14,000
Petroleum:					
Crude thousand 42-gallon barrels	154,417	181,868	209,939	187,196	[2]200,478
Refinery products:					
Gasoline:					
Aviation do.	1,023	1,281	1,177	1,077	[2]1,437
Motor do.	94,214	96,642	99,702	96,456	[2]97,636
Jet fuel do.	14,836	16,452	16,373	17,225	[2]18,387
Kerosene do.	761	812	611	597	[2]382
Distillate fuel oil do.	53,128	55,273	54,673	53,896	[2]58,104
Residual fuel oil do.	19,898	18,086	18,019	13,162	[2]14,031
Lubricants do.	3,324	3,753	3,692	3,358	[2]3,873
Liquefied petroleum gas do.	4,027	4,600	6,069	4,848	[2]4,844
Bitumen do.	2,766	3,171	3,220	3,412	[2]3,157
Unspecified do.	10,879	9,943	7,476	5,716	[2]7,013
Refinery fuel and losses do.	13,433	11,872	11,739	10,976	9,569
Total do.	218,289	221,885	222,751	210,723	218,433

[e]Estimated. [p]Preliminary. [r]Revised.

[1]Includes data available through Aug. 23, 1988.

[2]Reported figure.

[3]Data are for year ending June 30 of that stated.

[4]Bismuth-rich residues reportedly have been stockpiled owing to weak demand and low prices.

[5]Excludes gold in bismuth concentrate.

[6]Excludes gold in gold ore and concentrate for South Australia.

[7]Data are for year ending Nov. 30 of that stated for plants owned by The Broken Hill Pty. Co. Ltd.

[8]Western Australia only. Platinum-group metals content of nickel ore.

[9]Excludes tin content of copper-tin concentrates.

[10]Excludes production from Western Australia.

[11]Production of kyanite began in 1982 (80 tons) as a byproduct of mineral sands mining at Eneabba, Western Australia.

[12]In addition, about 7,000 tons of sillimanite clay, also known as kaolinized sillimanite, is produced, containing 40% to 48% Al_2O_3.

[13]Excludes data from some States.

TRADE

The value of Australia's mineral exports in 1985, the latest year for which official data were available, rose 34% over that of 1984, setting a record high of $10.4 billion. The volume of exports of all major minerals increased, except for tin and zinc. The largest export earner was coal, which rose 31% in value and represented 34% of the value of total primary mineral exports. Iron ore and pellets remained the second largest export earner, the value increasing 24%. Crude oil exports rose 140% to become the third largest export earner, displacing alumina and aluminum into fourth and fifth places, respectively. Substantial contributions were also made by refined copper, gold, lead, mineral sands, nickel, uranium, and zinc.

The value of imported primary mineral products decreased 2% in 1985 to $1.4 billion, the lowest level since 1979. Crude oil dominated mineral imports, but its value decreased 10% and accounted for 74% of the value of total primary mineral imports. The decrease in crude oil more than offset increases in all other major mineral imports: gold bullion, 131%; elemental sulfur, 46%; ferroalloys, 37%; diamond, 36%; and phosphate rock, 15%. Other significant mineral import items, in order of magnitude, were potassium fertilizers, platinum, asbestos, magnesium, clays, limestone, and magnesite.

Table 2.—Australia: Exports and reexports of mineral commodities[1]

(Metric tons unless otherwise specified)

Commodity	1985	1986	Destinations, 1986	
			United States	Other (principal)
METALS				
Aluminum:				
Oxides and hydroxides thousand tons	7,158	7,698	NA	Singapore 20; Republic of Korea 8; unspecified 7,669.
Metal including alloys:				
Scrap	19,175	48,022	3,383	Japan 35,736; Republic of Korea 2,602.
Unwrought	564,897	582,509	25,589	Japan 292,620; Republic of Korea 70,881; China 65,484.
Semimanufactures	61,300	58,810	14	Hong Kong 4,809; Singapore 2,6[illegible]; unspecified 47,451.
Antimony: Ore and concentrate	2,834	1,549	--	Belgium-Luxembourg 854; France 539; Netherlands 115.
Chromium: Ore and concentrate	9	--		
Copper:				
Ore and concentrate	291,158	247,687	2,722	Japan 184,015; Republic of Korea 20,003; Finland 15,385.
Matte and speiss including cement copper	8,001	--		
Metal including alloys:				
Scrap	322	177	--	India 72; United Kingdom 34; Belgium-Luxembourg 29.
Unwrought	73,192	68,421	82	United Kingdom 29,148; Japan 24,747; West Germany 9,165.
Semimanufactures	27,990	13,474	1,230	New Zealand 7,700; Singapore 981; Malaysia 723.
Gold:[2]				
Ores and concentrates, Au content troy ounces	61,761	89,893	NA	NA.
Metal including alloys, unwrought and partly wrought do.	1,541,883	1,796,870	NA	Japan 1,288,214; Hong Kong 188,596; United Kingdom 139,888.
Iron and steel:				
Iron ore and concentrate excluding roasted pyrite thousand tons	88,280	82,735	--	Japan 48,554; China 8,709; Republic of Korea 5,274.

See footnotes at end of table.

Table 2.—Australia: Exports and reexports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1985	1986	Destinations, 1986: United States	Destinations, 1986: Other (principal)
METALS —Continued				
Iron and steel —Continued				
Metal:				
Scrap	503,055	565,535	--	Hong Kong 8,339; New Zealand 1,448; unspecified 550,029.
Pig iron, cast iron, related materials	3,640	26,756	--	Singapore 26,120.
Ferroalloys:				
Ferromanganese	20,055	44,345	12,200	Indonesia 14,641; Qatar 9,118.
Unspecified	55,496	42,189	15,000	Japan 7,150; Belgium-Luxembourg 6,376; Indonesia 3,971.
Steel, primary forms	787,279	514,008	58,266	China 178,990; Iran 99,790; Jordan 42,224.
Semimanufactures:				
Bars, rods, angles, shapes, sections	183,859	202,040	10,049	China 139,031; New Zealand 29,043; Papua New Guinea 13,600.
Universals, plates, sheets	4,697,049	363,389	139,957	New Zealand 40,512; Pakistan 39,298; China 27,854.
Hoop and strip	17,278	16,269	2,497	New Zealand 8,230; Singapore 2,825; Canada 1,326.
Rails and accessories	13,576	1,661	8	Canada 1,414; Indonesia 154.
Wire	311,622	16,588	3,734	New Zealand 3,662; Papua New Guinea 2,226; Hong Kong 1,921.
Tubes, pipes, fittings	33,632	71,836	9	Singapore 1,261; Malaysia 1,131; unspecified 65,888.
Castings and forgings, rough	5959	18,219	1,399	Papua New Guinea 6,410; Malaysia 4,562; India 1,803.
Lead:				
Ore and concentrate	199,845	230,780	31,849	Japan 60,821; Belgium-Luxembourg 51,236; Sweden 22,565.
Oxides	3,698	3,823	--	Indonesia 492; Singapore 404; unspecified 2,388.
Metal including alloys:				
Scrap	19,993	26,993	80	Republic of Korea 14,864; Philippines 3,564; India 950.
Unwrought	306,254	304,901	--	United Kingdom 155,186; India 41,958; Japan 29,144.
Semimanufactures	2,688	404	--	New Zealand 126; Singapore 99; Philippines 90.
Manganese: Ore and concentrate[3] thousand tons	1,403	1,145	NA	NA.
Nickel:				
Ore and concentrate value, thousands	$9,505	$112	--	Japan $101.
Matte and speiss do.	$231,784	$212,454	--	NA.
Metal including alloys:				
Scrap	600	329	--	United Kingdom 141; Japan 131.
Unwrought and semimanufactures value, thousands	$106,848	$81,551	NA	NA.
Platinum-group metals: Metals including alloys, unwrought and partly wrought do.	$1,245	$2,681	$991	United Kingdom $730; Hong Kong $628.
Rare-earth metals: Monazite concentrate[3]	r18,024	14,100	NA	France 12,725.
Silver:				
Ore and concentrate[3] value, thousands	$21	$5,463	$8	Japan $5,433.
Waste and sweepings[3] do.	$2,537	$3,920	--	United Kingdom $2,743; Japan $1,072.
Metal including alloys, unwrought and partly wrought do.	$39,878	$42,572	--	United Kingdom $22,252; Thailand $3,831; Singapore $3,779.

See footnotes at end of table.

Table 2.—Australia: Exports and reexports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1985	1986	Destinations, 1986	
			United States	Other (principal)
METALS —Continued				
Tin:				
Ore and concentrate	11,860	15,810	--	Malaysia 14,687.
Metal including alloys:				
Scrap	73	1,381	--	Malaysia 249; unspecified 1,027.
Unwrought	437	229	77	New Zealand 84; Malaysia 36.
Semimanufactures	83	1,392	1,088	New Zealand 139; Hong Kong 80.
Titanium: Ore and concentrate[2] thousand tons	1,380	1,277	537	United Kingdom 234; Japan 180.
Tungsten:				
Ore and concentrate	3,416	2,654	283	West Germany 580; unspecified 1,793.
Metal including alloys, all forms	91	157	1	West Germany 108; Netherlands 38.
Uranium and thorium: Ore and concentrate value, thousands	$226,062	$254,829	$60,386	France $73,028; United Kingdom $46,155; West Germany $43,859.
Zinc:				
Ore and concentrate:				
thousand tons	881	936	6	Japan 525; West Germany 145; Belgium-Luxembourg 100.
Oxides	2,938	510	--	New Zealand 346; China 68; Republic of Korea 40.
Metal including alloys:				
Scrap	903	1,249	--	Republic of Korea 115; unspecified 1,038.
Unwrought	209,807	236,969	40,168	Indonesia 45,823; Hong Kong 16,777; Japan 13,196.
Semimanufactures	9,388	502	--	New Zealand 243; Singapore 84; Fiji 32.
Zirconium: Ore and concentrate[3]	495,891	445,690	34,857	Japan 160,022; Italy 67,061.
Other:				
Ores and concentrates	r20	--		
Oxides and hydroxides	39	--		
Ashes and residues	55,198	854,967	--	United Kingdom 805,960; Japan 17,920.
Base metals including alloys, all forms	855	955	657	Netherlands 68; India 44.
INDUSTRIAL MINERALS				
Abrasives, n.e.s.:				
Natural: Corundum, emery, pumice, etc	2,599	2,572	921	Japan 587; Thailand 323; United Kingdom 305.
Artificial: Corundum	2	19	--	New Zealand 17.
Dust and powder of precious and semiprecious stones including diamond value, thousands	$11	$61	$34	United Kingdom $18.
Grinding and polishing wheels and stones	1,722	188	--	New Zealand 137.
Barite and witherite	2,041	1,242	--	New Zealand 1,085.
Cement	(4)	18,490	--	Papua New Guinea 16,090; New Zealand 672.
Clays, crude	8,576	16,615	--	Japan 8,808; Netherlands 2,715; United Kingdom 2,108.
Diamond:				
Gem, not set or strung value, thousands	$21,077	$18,893	$5,503	Belgium-Luxembourg $5,032; Switzerland $1,934.
Industrial stones do.	$2,571	$6,852	$148	Switzerland $4,953; New Zealand $280.
Diatomite and other infusorial earth	123	189	--	Philippines 70; New Zealand 39; Papua New Guinea 32.

See footnotes at end of table.

Table 2.—Australia: Exports and reexports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1985	1986	Destinations, 1986	
			United States	Other (principal)
INDUSTRIAL MINERALS —Continued				
Fertilizer materials:				
Crude, n.e.s	821	4,937	--	Philippines 2,234; Japan 1,628; Italy 754.
Manufactured:				
Ammonia	65,963	79,282	--	India 32,445; Republic of Korea 16,489; Thailand 5,429.
Nitrogenous	4,175	14,342	--	Singapore 7,165; New Zealand 2,858; Indonesia 2,483.
Phosphatic	158	10,748	10,348	Papua New Guinea 393.
Potassic	30	6	--	Papua New Guinea 2.
Unspecified and mixed	6,084	1,032	--	Papua New Guinea 560; Tonga 119; Samoa 90.
Graphite, natural	72	49	6	New Zealand 43.
Gypsum and plaster	520,840	428,588	25,531	Indonesia 148,737; New Zealand 118,144; Japan 50,358.
Lime	87	233	--	Nauru 121; Vanuatu 65; China 20.
Magnesium compounds: Magnesite, crude	5,445	2,679	40	New Zealand 2,428.
Mica: Worked including agglomerated splittings	(*)	16	(*)	Mainly to Papua New Guinea.
Nitrates, crude	41	9	--	Papua New Guinea 6.
Phosphates, crude	10,034	22,846	1	Japan 15,300; Republic of South Africa 7,500.
Pigments, mineral: Iron oxides and hydroxides, processed	171	167	--	Thailand 55; New Zealand 49; Singapore 34.
Potassium salts, crude	43	--	--	
Precious and semiprecious stones other than diamond, synthetic value, thousands	$21,087	$27,251	$1,667	Japan $7,785; Thailand $7,747; Hong Kong $5,479.
Salt and brine thousand tons	4,947	5,272	(*)	Japan 3,269; Republic of Korea 778; Brazil 123.
Sodium compounds, n.e.s.: Carbonate, manufactured	2,648	7,207	--	New Zealand 4,464; Fiji 1,550; Singapore 566.
Stone, sand and gravel:				
Dimension stone:				
Crude and partly worked	2,539	5,235	--	Italy 4,835; New Zealand 263.
Worked	287	5	--	New Zealand 4.
Dolomite, chiefly refractory-grade	36	43,555	--	All to Japan.
Gravel and crushed rock	894,993	1,139,464	26	Japan 5,510; Vanuatu 600; unspecified 1,132,914.
Limestone other than dimension	76	21	--	Fiji 19.
Sulfur:				
Elemental: Crude including native and byproduct	3,934	1,180	--	New Zealand 917; Indonesia 121.
Sulfuric acid	489	209	--	Papua New Guinea 71; Fiji 69; New Zealand 24.
Talc, steatite, soapstone, pyrophyllite	122,349	183,376	14,005	Japan 120,312; Republic of Korea 15,745; Netherlands 15,252.
Other:				
Crude	11,285	32,275	18,577	Japan 16,247; Netherlands 4,718; France 2,475.
Slag and dross, not metal-bearing	92	13,340	--	Singapore 8,204; Norway 5,060.
MINERAL FUELS AND RELATED MATERIALS				
Carbon black	25,148	27,766	--	Indonesia 12,999; New Zealand 5,712; Republic of Korea 1,734.
Coal:				
Anthracite and bituminous thousand tons	88,751	92,256	57	Japan 42,630; Republic of Korea 8,518; France 4,456.
Lignite including briquets do.	26	53	--	Republic of Korea 39; Italy 4; Japan 4.
Coke and semicoke do.	168	471	(*)	India 236; Republic of Korea 85; Romania 60.

See footnotes at end of table.

Table 2.—Australia: Exports and reexports of mineral commodities[1] —Continued

(Metric tons unless otherwise specified)

Commodity	1985	1986	Destinations, 1986	
			United States	Other (principal)
MINERAL FUELS AND RELATED MATERIALS —Continued				
Petroleum:				
Crude . thousand 42-gallon barrels	41,380	24,019	16,982	Japan 3,128; Singapore 1,991.
Refinery products:				
Liquefied petroleum gas do.	18,670	19,570	NA	NA.
Gasoline do.	2,700	2,093	13	Fiji 619; New Zealand 495; Papua New Guinea 431.
Mineral jelly and wax do.	14	18	--	New Zealand 11; Malaysia 3.
Kerosene and jet fuel do.	5,843	6,093	7	Fiji 754; New Zealand 519; bunkers 4,063.
Distillate fuel oil do.	4,895	4,697	42	Papua New Guinea 1,038; Fiji 844; New Zealand 626.
Lubricants do.	1,472	1,238	95	New Zealand 297; Singapore 161; Hong Kong 145.
Residual fuel oil do.	8,983	10,075	1,661	Singapore 2,058; Papua New Guinea 1,409; bunkers 4,437.
Bitumen and other residues do.	--	1	--	Mainly to Tonga.
Bituminous mixtures do.	[5]	3	--	New Zealand 1; Vanuatu 1.

[r]Revised. NA Not available.
[1]Table prepared by Audrey D. Wilkes. Import data for 1985 and 1986 were not available at the time of publication.
[2]Data from Australian Mineral Industry Annual Review Preliminary Summary 1987.
[3]May include platinum-group metals.
[4]Unreported quantity valued at $1,534,000.
[5]Unreported quantity valued at $24,000.
[6]Less than 1/2 unit.

COMMODITY REVIEW

METALS

Aluminum, Alumina, and Bauxite.—The production of aluminum rose 14% over that of 1986, while alumina production increased 7% and bauxite production increased 5% during 1986. Production for all three established record highs. Aluminum production increased primarily because the five established smelters—Bell Bay in Tasmania; Boyne Island, Queensland; Kurri Kurri, New South Wales; Point Henry, Victoria; and Tomago, New South Wales—operated at nearly 100% of capacity. Production at the sixth smelter in Portland, Victoria, which went on-line in November 1986, was at about 70% of capacity. The increase in alumina was due mainly to increased production at the Gladstone refinery to meet higher world demand.

Exports of bauxite in 1987 decreased 10% to 4.5 million tons. Alumina and aluminum exports, however, increased 8% and 21%, respectively, attaining record highs of 8.3 million tons and 700,000 tons.

A proposal for a two-potline, 280,000-ton-per-year smelter with an associated power station was submitted to the Western Australian government by Western Australian Aluminium Smelter Consortium Ltd. near yearend. The proposal designated a site near Bunbury, south of Perth, for the smelter. The first potline would be commissioned in 1992 and the second in 1996.

BHP-Utah Minerals International Inc. announced in July its intention to sell its 20% share in the 1-million-ton-per-year alumina refinery and associated bauxite mine at Worsley, Western Australia. By yearend, it had conditionally agreed to the sale to Hydro Aluminium A/S of Norway. The conditions included approval by the Australian Government and agreement of the other joint-venture partners, Reynolds Australia Alumina Ltd., 40%, Shell Co. of Australia Ltd., 30%, and Kobe Alumina Associates, 10%.

Aluvic, a join venture in which the Victoria State government holds a 35% share, was looking into the possibility of constructing a $22.5 to $30 million aluminum casting plant at its Portland smelter.

Copper.—Mine production of copper continued to decline in 1987, decreasing 10%,

owing to decreased output at Australia's two largest copper mines, Mount Isa Mine, Queensland, and Mount Lyell Mine, Tasmania. Production decreased at the Woodlawn Mine, New South Wales, during the changeover from surface to underground mining. The small Warrego Mine, near Tennant Creek, Northern Territory, ceased copper production in February.

Construction progressed on schedule to meet the October 1, 1988, target date for the first copper metal pour at the on-site refinery at the huge Olympic Dam copper-gold-silver-uranium project at Roxby Downs Station, South Australia, owned by Roxby Mining Corp. Pty. Ltd., a subsidiary of Western Mining Corp. Holdings Ltd. (WMCH), 51%, and BP Australia Ltd., 49%. Scheduled production was to be 30,000 tons of cathode-grade copper bar per year produced from 1 million tons of copper-uranium ore. The refinery will use the Isa process technology developed by Copper Refineries Pty. Ltd., a wholly owned subsidiary of MIM Holdings Ltd.

A joint venture consisting of Cyprus Minerals Australia Co., 37.5%, Arimco NL, 37.5%, and Elders Resources Ltd., 25%, announced in midyear plans to develop the Starra copper-gold deposit and to commission a processing plant the first quarter of 1988. Mining was planned at a rate of 750,000 tons of ore per year to produce 10,000 tons of copper-in-concentrate. Starra is 150 kilometers southeast of Mount Isa.

Renison Goldfields Consolidated Ltd. announced that underground mining at its Mount Lyell Mine, Queenstown, Tasmania, will continue beyond the previously scheduled closure date of June 1989, following a pledge of financial assistance from the Tasmanian State government. The aid will enable the selective mining of 7.5 million tons of ore grading 1.95% copper from the deeper 50 and 60 series stopes. Mine closure is likely to be in 1994, following the completion of mining the 60 series stope.

Barrack Mines Ltd., the operator holding a 66% interest, announced the development of the polymetallic-mineralized deeper levels of the Horseshoe Lights gold mine, 135 kilometers north of Meekatharra, Western Australia. A plant was under construction for the production of 60,000 tons of copper concentrate beginning in the first quarter of 1988. Eastern Petroleum Australia Ltd., 28.5%, and Samantha Exploration NL, 5.5%, were the other partners in the mine.

Gold.—The production of gold in Australia, which increased for the seventh consecutive year, was 3.47 million troy ounces in 1987, an increase of 44% and the highest since 1906. Australia's peak gold production, 3.8 million ounces, was attained in 1903.

The Telfer Mine in Western Australia, owned and operated by Newmont Holdings Pty. Ltd., 70%, and BHP Gold Mines Ltd., 30%, replaced the Kidston Mine, Queensland, as Australia's preeminent gold producer. The Kidston Mine, owned by Canada's Placer Development Ltd., 70%, Australia's Elders IXL Ltd., 15%, and Australian public shares, 15%, remained Queensland's largest producer. The Granites Mine, owned by North Flinders Mines Ltd., displaced the Enterprise Mine, owned by Renison Goldfields, 60%, and Enterprise Gold Mines NL, 40%, as the Northern Territory's biggest producer. The Stawell Mine, a joint venture of WMCH, 75%, and Central Norseman Gold Corp., 25%, remained Victoria's major producer. Paragon Resources Ltd.'s Temora gold-silver mine, commissioned in May, became the largest gold mine in New South Wales, supplementing byproduct gold produced from base metal mining. Although commencement of production at the Olympic Dam deposit at Roxby Downs Station will considerably expand gold output, South Australia remained a small producer in 1987. Production of gold in Tasmania remained primarily a byproduct of base metal mining.

Exploration for gold accounted for more than 50% of the amount spent on exploration for nonfuel minerals in 1987, resulting in the discovery of numerous potential gold mines, primarily extensions of known ore trends. A few sites were virgin ore bodies. A partial list of gold mines and treatment plants commissioned during the year is as follows: Agricola, Queensland (Astrik Resources NL); Bardoc, Western Australia (Aberfoyle Exploration Pty. Ltd., 57%, and Hill Minerals NL, 43%); Bellevue, Western Australia (Queen Margaret Gold Mines NL, 50%, and Spargos Exploration NL, 50%); Boddington, Western Australia (Worsley Joint Venture Partners—Reynolds Australia, 40%, Shell Australia, 30%, BHP Gold, 20%, and Kobe Alumina Associates, 10%); Cosmo Howley, Northern Territory (Dominion Gold Mines NL, 50%, Regent Mining Ltd., 45%, and Southern Goldfields Ltd., 5%); Cracow, Queensland (Costain Securities (NSW) Pty. Ltd., 50%, Sedimentary Holdings Ltd., 37.5%, and Cracow Gold Ltd.,

12.5%); Croydon, Western Australia (Central Coast Exploration NL); Gabanintha, Western Australia (Dominion Gold, 50%, Southern Ventures NL, 25%, Black Swan Gold Mines NL, 25%); Gidgee, Western Australia (Montague Gold NL, 47%, Cyprus Minerals Australia, 26.5%, and Hudspeth & Co. Ltd., 26.5%); Gibralter, Western Australia (Pan Australian Mining Ltd.); Goongarrie, Western Australia (Julia Mines NL); Hellyer, Tasmania (Aberfoyle Ltd.); Kurara (Nord Resources (Pacific) Pty. Ltd.); Mertondale, Western Australia (Hunter Resources Ltd.); Mount Fisher, Western Australia (Sundowner Minerals NL); New Celebration, Western Australia (Newmont Holdings, 60%, Hampton Australia Ltd., 25%, Mount Martin Gold Mines NL, 15%); Pajingo, Queensland (Pajingo Gold Mines Pty. Ltd.); Premier, Western Australia (Kalgoorlie Resources NL); Sheahan-Grants, New South Wales (Climax Mining Ltd., 50%, Cyprus Minerals Australia, 25%, Arimco, 25%); Temora, New South Wales (Paragon Resources); White Devil, Northern Territory (Australian Development Ltd.); and Youanmi, Western Australia (Eastmet Ltd.).

An $11 million precious metals refinery, the first of its kind in Australia, was planned for Sydney, New South Wales, to produce gold and silver bullion from residues and scrap. It would be built by the joint-venture Pacific Precious Metals Ltd. The refinery was scheduled to be operational by December 1988. The joint venture comprised Toiltreck Systems Ltd., 40%; MIM Holdings, 30%; and Noranda Minerals Inc., 30%.

The Golconda Minerals NL and Minefields Exploration NL 50-50 joint venture announced plans to develop the old Mount Mulgine molybdenum-tungsten deposit, 85 kilometers northeast of Perenjori, Western Australia, into an open pit gold mine. Reserves at Mount Mulgine were 47.5 million tons of molybdenum-tungsten ore with significant gold values, up to 3.5 grams per ton, plus silver. Exploration and further delineation of reserves was scheduled through June 1990.

At yearend, Western Australia was planning to establish an international gold bank, to be owned by the State and headquartered in Perth. The Gold Banking Corp. would issue notes backed by gold bullion or by Australian Nuggets, Australia's legal tender, 99.99%-gold coins. This would make Australia the only country in the world to issue gold-backed notes. The Gold Bank would also operate the Perth Mint and gold refinery and assume the crushing, milling, and gold recovery operations previously done by the Western Australian State Batteries.

Peko-Wallsend Ltd. announced plans at yearend to build a carbon-in-pulp gold recovery plant to treat the accumulated tailings at the Warrego Mine. The tailings reserve was 4.5 million tons grading 1.03 grams of gold per ton. More than 90,000 ounces of gold will be reclaimed.

Croesus Mining NL and Indian Ocean Resources Ltd. entered into a joint-venture agreement to treat 2 million tons of tailings at Lakewood Trailings near Kalgoorlie in Western Australia. About 30,000 ounces of gold were expected to be recovered.

Plans for the Starra copper-gold deposit, described in the "Copper" section, were to produce 500,000 tons of ore per year from four separate open pits and an additional 250,000 tons per year from underground, extracting a total of 100,000 ounces of gold.

The Broken Hill Pty. Co. Ltd. (BHP) transferred into a separate gold company, BHP Gold Ltd., all of its gold interests, excluding its stake in the Ok Tedi Mine in Papua New Guinea and those interests held by its Utah International Div. BHP retained a 55% holding in the new company and continued to manage the properties and market the gold. The remaining shares were offered to BHP shareholders. Among the new company's interests were Boddington, Western Australia, 20%; Browns Creek, New South Wales, 100%; Coronation Hill, Northern Territory, 45%; Gympie, Queensland, 55%; Ora Banda, Western Australia, 100%; and Telfer, Western Australia, 30%.

Iron and Steel.—Production of iron ore in 1987 increased 6%, breaking the previous record high set in 1975. The increase reflected the effectiveness of programs to expand production at some mines, the policy of building stocks at port facilities by the major producers, and a strengthening in export demand, especially during the second half of the year, following a higher level of steel production in Japan and Western Europe. However, iron exports decreased 3%. A surge in iron ore exports during the last half of the year did not offset the reduced level of shipments earlier in the year. Iron ore contract prices negotiated early in the year were down another 4% to 9% from the previous year, due to an

excess of supplies in the world market.

Production of pig iron and steel were adversely affected by industrial disputes and decreased 5% and 10%, respectively, from that of 1986. Output of steel produced by BHP's steel division decreased 10% at the Newcastle Steelworks, New South Wales; 12% at the Port Kembla Steelworks, Wollongong, New South Wales; and 1% at the Whyalla Steelworks, South Australia, all relative to the previous year.

Australian iron ore production remained heavily concentrated in the Pilbara District of Western Australia, which accounted for more than 95% of production. Hamersley Iron Pty. Ltd., the major Pilbara producer and wholly owned by CRA Ltd., reached agreement with the China Metallurgical Import and Export Corp. (CMIEC) in June to jointly develop the 200-million-ton Channar iron ore deposit, 20 kilometers east of Hamersley Iron's Paraburdoo Mine. Construction was to begin in early 1988. Production was to begin in 1990 at the rate of 3 million tons per year, progressively increasing to 10 million tons per year. The open cut would use Hamersley Iron's existing plant, rail, and port. Channar production was to be blended with output from Hamersley Iron's other mines. The Channar project would be the first overseas mining project in which China held a direct equity interest. It also would be the first new development in the Pilbara since 1973. It was to be operated as a joint venture by Hamersley Iron and CMIEC, with Channar Mining Pty. Ltd. holding 60% and CMIEC Channar, 40%.

Robe River Iron Associates purchased BHP's 50% interest in the Robe River project's railway and Cape Lambert port facilities, as well as BHP's remaining Deepdale pisolitic limonite iron ore resources in February. These ore bodies, estimated to exceed 2 billion tons, were adjacent to Robe River's Pannawonica (East Deepdale) Mine.

An agreement was reached in May between Mount Newman Mining Co. Pty. Ltd. and Hancock Mining Ltd. providing for the limited mining of Hancock Mining's McCameys Monster iron ore mine, 35 kilometers southeast of Mount Newman, by Mount Newman Mining at the rate of 750,000 tons per year. Mount Newman Mining was to service the iron ore contracts, which Hancock Mining had negotiated with the Romanian Government, with ore from the Mount Newman Mine beginning in 1988 while McCameys Monster was being developed.

In May, BHP commissioned its $35 million, 130,000-ton-per-year-capacity steel minimill at Acacia Ridge in the Brisbane area. The steel rolling mill will produce merchant and reinforcing bar products and specialized rods using semifinished billets supplied by BHP's plant at Newcastle. The mill will be operated by BHP Queensland Steel Ltd. BHP announced it would build a small steel mill at Rooty Hill, Sydney, with a capacity to produce 250,000 tons of merchant bar products per year from steel scrap. The mill was tentatively scheduled to come on-stream in 1989.

The installation of a continuous bloom caster and reheat furnace was completed at BHP's Newcastle Steelworks in April.

Mount Newman Mining announced that it would expand production capacity at its Orebody 29 Mine, 2 kilometers south of Mount Newman Mining's operation at the huge Mount Whaleback Mine. The upgrade, from 2 million to 5 million tons per year, would cost $32 million. The work will include a new ore-handling plant, additional mining equipment, new train-loading facilities for the ore, a new conveyor, modifications of the Nelson Point facilities at Port Hedland, Western Australia, and some additional infrastructure at Mount Newman.

At its Laverton, Victoria, minimill, Humes Smorgon Steel Pty. Ltd. will increase billet and merchant-bar production capacity from 200,000 tons per year to 308,000 tons per year. Other planned improvements include new melting facilities, a rod mill, and new scrap-handling equipment.

Commonwealth Steel Co. Ltd. commissioned a new 50-ton-capacity electric arc and ladle furnace at its Waratah, New South Wales, works early in the year, increasing production capacity for special alloy steels from 108,000 tons per year to 130,000 tons per year.

Lead and Zinc.— In 1987, mine production of lead and zinc increased 6% and 11%, respectively, owing primarily to the return to production without work stoppages at the mines at Broken Hill, New South Wales, and the startup of production at Aberfoyle's Hellyer copper-lead-silver-zinc mine in Tasmania. Australia remained the world's leading producer of mined lead and third leading producer of mined zinc, after Canada and the U.S.S.R. Lead production increased slightly at the Woodcutters Mine, owned by Nicron Resources Ltd., 77%, Lachlan Re-

sources NL, 12.5%, and Petrocarb Exploration NL, 10.5%, in the Northern Territory; decreased slightly at Cobar Mines Pty. Ltd.'s Cobar Mine and Denehurst Ltd.'s Woodlawn Mine, both in New South Wales; and remained about the same as that of 1986 at MIM Holdings' Mount Isa Mine, and North Broken Hill Ltd.'s mines at Rosebery, Tasmania, and Elura, New South Wales. Mined zinc production increased at the Cobar Mine; decreased at the Mount Isa, Woodcutters, and Woodlawn Mines; and remained about the same as that of the previous year at the Elura and Rosebery Mines.

Lead bullion production increased 5% primarily because of the increased production of mined lead at Mount Isa. Lead bullion was produced at the on-site smelter at Mount Isa and at the Cockle Creek smelter, New South Wales, owned by the Sulphide Corp. Pty. Ltd., a wholly owned subsidiary of CRA. Production of primary refined lead increased at Broken Hill Associated Smelters Pty. Ltd.'s (BHAS) Port Pirie refinery. The refinery, Australia's sole producer, had experienced shortages of lead concentrate feedstock in 1986 because of work stoppages at the Broken Hill mines between May 26 and July 22. Estimated production of refined lead from secondary sources increased 5%.

Primary refined zinc production was slightly higher in 1987. It increased at Electrolytic Zinc Co. of Australasia Ltd.'s Risdon, Tasmania, refinery and at the Port Pirie refinery, but decreased slightly at the Cockle Creek refinery.

Underground development, trial mining, and metallurgical testing continued at MIM Holdings' Hilton lead-silver-zinc mine, 20 kilometers north of Mount Isa. High-grade ore was extracted at a rate of 2,000 tons per week and trucked to Mount Isa for processing in the lead-zinc concentrator. It was being planned that a commercial mine would begin operating in the late 1980's at Hilton, integrating its ore with that of Mount Isa. Production would be increased to about 2.5 million tons per year by the mid-1990's to offset declining production at Mount Isa. Reported primary reserves at the end of June were 11 million tons of proven ore grading 6.7% lead, 9.1% zinc, and 154 grams of silver per ton and 38 million tons of probable ore grading 6.4% lead, 9.3% zinc, and 150 grams of silver per ton.

Mining operations began at the Cadjebut lead-zinc deposit in the Kimberley District of northwestern Western Australia in June. The mine is a joint venture between BHP, 58%, and Billiton Australia Ltd., 42%. The high-grade ore was stockpiled on-site until the concentrator came on-stream in the first quarter of 1988. The mine was expected to produce 320,000 tons of ore per year, producing concentrates of 80,000 tons grading 55% zinc and 17,000 tons grading 75% lead annually. All concentrate was to be shipped to Southeast Asia, Europe, and other parts of Australia from the Western Australia port of Wyndham. Operations at Cadjebut marked the first base metal mining by BHP since it ceased operations at its namesake, the Broken Hill Mines in New South Wales in 1939.

A fire in a sinter plant control room at yearend caused a 6-week closure of the Port Pirie refinery, resulting in the loss of 20,000 tons of refined lead. Contractual commitments were maintained, however, from inventory stockpiled for use during the scheduled shutdown for maintenance in January 1988. Production of refined zinc continued, although at about 70% to 75% of nominal capacity.

BHAS will upgrade its facilities at Port Pirie over a 4-year period beginning in 1988 to comply with environmental regulations, to increase operating flexibility, and to maintain production.

Aberfoyle announced at yearend an $84 million program to quadruple mining operations and construct a new 1-million-ton-per-year ore treatment plant at its Hellyer underground mine, Tasmania, which came on-stream earlier in the year. The mine had been using the old Cleveland tin milling facility, which had been converted to process 250,000 tons of copper-lead-silver-zinc ore. Average production at a 1-million-ton-per-year throughput, will be 45,000 tons of lead concentrate, 170,000 tons of zinc concentrate, 100,000 tons of bulk lead-zinc concentrate, and 10,000 tons of copper-silver concentrate. Gold is also present in the ore, but recovery is likely to be minimal because of the ore's refractory nature. The project was scheduled to be completed in early 1989 and was to gradually replace output from Aberfoyle's Que River Mine, scheduled for closure in 1991.

Electrolytic Zinc commissioned a feasibility study early in the year on expanding the Risdon, Tasmania, zinc smelter-refinery by up to 45% to 320,000 tons per year. This would be in addition to the 4-year moderni-

zation program begun at the start of the year to replace the leaching and purification plant.

The major mines at Broken Hill began operating under revised conditions in February after the miners voted to accept the recommendations of the New South Wales Industrial Commission that the number of weekly shifts be increased to 21 from 19 and that some safety practices be changed. The dispute over the proposed changes and the unions' refusal to accept them led to a 2-month shutdown beginning in May 1986. The miners returned to work in July 1986, under an interim agreement that increased the number of shifts from 15 to 19.

Manganese.—Production of manganese ore in Australia, all on Groote Eylandt in the Gulf of Carpentaria, Northern Territory, by Groote Eylandt Mining Co. Pty. Ltd., a wholly owned subsidiary of BHP, increased 12% owing to the completion of a modernization program that raised the ore treatment capacity from 750 to 1,000 tons per hour and concentrate production capacity from 2.3 to 2.4 million tons per year.

Manganese alloy (ferromanganese and silicomanganese) production at the Bell Bay plant by Tasmanian Electro Metallurgical Co. Pty. Ltd., also wholly owned by BHP, increased by more than 40% following the completion in midyear of a 3-year expansion program that raised production capacity from 135,000 to 190,000 tons per year.

Late in the year, BHP announced through its wholly owned subsidiary BHP-Utah Minerals International that it planned to build a plant at Newcastle, New South Wales, to produce electrolytic manganese dioxide used in the manufacture of dry cell batteries. Beginning in late 1989, the plant, to be fed with ore from the Groote Eylandt Mine, was to have the capacity to produce 15,000 tons of manganese dioxide per year, about 10% of the combined capacity of market economy countries. About 90% of production was to be exported.

BHP announced an agreement with CMIEC for a feasibility study on establishing in China a 60,000-ton-per-year manganese ferroalloy plant that would be fed by ore from the Groote Eylandt Mine. A decision to proceed would increase the average 170,000-ton-per-year shipments of manganese ore to China and probably establish a 50-50 joint venture.

Mineral Sands.—Australian producers of mineral sands, which are high concentrations of the heavy-minerals rutile, ilmenite (including leucoxene), zircon, and monazite, operated at full mining capacity throughout the year, with estimated production of concentrates increasing by 7%. Australia retained its ranking as the world's leading producer and exporter of mineral sands, producing an estimated 40% to 60% of world production. Ilmenite production increased 11%, monazite output decreased 14%, rutile production increased 19%, and zircon production decreased 3%. Leucoxene production decreased 14%.

The TiO_2 Corp. NL, 50%, and Kerr McGee Chemical Corp., 50%, announced plans to develop a mineral sands mine and concentrator at Cooljarloo, 170 kilometers north of Perth, as well as separate synthetic rutile (SR) and titanium dioxide (TiO_2) pigment plants. Annual production was expected to be 300,000 tons of ilmenite, 40,000 to 60,000 tons of zircon, 20,000 to 40,000 tons of rutile, and 2,500 tons of monazite. Production from the mineral sands plant was scheduled to start by mid-1989, the SR plant in January 1990, and the TiO_2 plant in mid-1990.

CRA reportedly discovered one of the world's largest deposits of heavy-mineral sands in the Horsham region of western Victoria. The deposit was described as having 1 billion tons of proven ore in the primary exploration area containing more than 3% heavy minerals and a larger resource of 4.9 billion tons averaging more than 2% heavy minerals. Estimated reserves in the primary exploration area were 12.5 million tons of ilmenite, 5.1 million tons of zircon, 4.6 million tons of leucoxene, 3.4 million tons of rutile and anatase, 580,000 tons of monazite, and 170,000 tons of xenotime.

Consolidated Rutile Ltd. commissioned its 175,000-ton-per-year low-chromium ilmenite upgrading plant at Meeandah, Queensland, in March. Consolidated Rutile was planning to increase the plant's capacity to 250,000 tons per year in mid-1988.

Westralian Sands Ltd. commissioned its 110,000-ton-per-year SR plant at North Capel, Western Australia, in February.

Associated Minerals Consolidated Ltd., the world's largest producer of mineral sands and a wholly owned subsidiary of Renison Goldfields, opened its third, and Australia's fourth, SR plant at Narngulu, near Geraldton, Western Australia, in

April. The plant will process ilmenite from the company's mines at Eneabba and at full capacity will produce 112,000 tons of SR per year.

Mineral Deposits Ltd., a wholly owned subsidiary of BHP, commissioned its new mining operation at Viney Creek, north of Newcastle, New South Wales, in midyear. The mineral sands concentrates were processed through the company's adjacent Hawks Nest plant.

Nickel.—Mine production increased at WMCH's mines at Mount Windarra and in the Kambalda-St. Ives areas of the Kalgoorlie District, both in Western Australia, as well as at Queensland Nickel Pty. Ltd.'s Greenvale Mine in Queensland. Nevertheless, Australia's nickel production decreased by 3% owing to the suspension of mining at two large mines in Western Australia—the Agnew Mine, owned by BP Australia, 60%, and MIM Holdings, 40%, in August 1986 and the Nepean Mine, owned by Metals Exploration Ltd., in May 1987. The Agnew Mine remained on care and maintenance, to be reopened when market conditions permit and the Nepean Mine was exhausted.

Nickel content of nickel matte produced at WMCH's Kalgoorlie nickel smelter decreased 2% from that produced in 1986, largely owing to the loss of available concentrate feed from the Agnew Mine. The decline was partially offset by increased production from the Kambalda Field and Mount Windarra. The nickel content of nickel oxide sinter produced at Queensland Nickel's Yabulu, Queensland, refinery near Townsville remained at about the same level as that of the previous year. Refined nickel from WMCH's Kwinana, Western Australia, nickel refinery increased 14%. Queensland Nickel was exploring the possibility of importing nickel ore from New Caledonia and/or Indonesia for treatment at the Yabulu plant. Yabulu was being fed with ore from the nearby Greenvale Mine, but its reserves will be exhausted by about 1991, and Queensland Nickel was looking into other source material to save the facility from closure. Yabulu employed about 700 people.

In November, Australia gave notice of its intention to become a foundation member of the new International Nickel Study Group, a producer-consumer forum designed to encourage information sharing about world nickel trade. The Study Group was to become effective when 15 countries, accounting for more than 50% of world nickel trade accept the terms of membership.

Tin.—Australian production of tin-in-concentrates decreased 12%. The Tolltreck Metal Products Ltd. tin smelter at Alexandria in Sydney, and Greenbushes Ltd.'s tin smelter at its tin-tantalum mine south of Perth, reduced smelting operations to part-time owing to the shortage of suitable concentrates. As a result, production of primary refined tin decreased by 57%.

Renison Goldfields' large, hard-rock, underground Renison Bell Mine in Tasmania produced at its 850,000-ton-per-year capacity throughout the year after returning to a 24-hour, 7-day-per-week schedule in April 1986. Renison continued to toll smelt its tin concentrates in Malaysia and to develop its own markets for the metal, which it began doing soon after the collapse of the International Tin Council in October 1985.

Kokan Mining Co. Ltd., a subsidiary of Nippon Kokan K.K. of Japan, and Greenbushes were planning to jointly mine tin and tantalum ore in the Pilbara District beginning in the spring of 1988. The tin and tantalum deposits, located about 200 kilometers south of Port Hedland, were first discovered by Greenbushes in the late 1970's. Kokan Mining established a subsidiary, Western Australia Rare Metals Co., to conduct further tests and feasibility studies between mid-1986 and mid-1987 with financial backing from the Metal Mining Agency of Japan. The production of tin and tantalum reportedly will be shared equally by Kokan Mining and Greenbushes.

Tungsten.—Australia remained one of the market economy countries' leading tungsten producers, despite the fall of 1987 production to about 32% of the peak reached in 1980, as a result of continued low prices and weak demand. Production of tungsten in concentrates decreased 28%. About 65% of output came from Peko-Wallsend's subsidiary, King Island Scheelite Pty. Ltd., which was producing from its Dolphin Mine on King Island, Tasmania. The remainder was produced by Tasmania Mines NL from its Kara Mine in northern Tasmania.

King Island Scheelite continued to operate at 50% of rated capacity at its Dolphin Mine. The company's Bold Head Mine on King Island remained on care-and-maintenance status. Production from the Kara Mine was reduced because of metallurgical problems at the mill and a reduction from three shifts to one shift per day.

Australia's second largest capacity tungsten mine, Mount Carbine near Cairns, Queensland, of Queensland Wolfram Pty. Ltd., owned by Poseidon Ltd., 66.6%, and R. B. Mining Pty. Ltd., 33.3%, remained on care and maintenance.

Virtually all production was exported, mainly to the Federal Republic of Germany, the United States, and the U.S.S.R. The only Australian consumer of domestic supplies was Seco-Titan Pty. Ltd., which used minor amounts for the production of ammonium paratungstate and tungsten carbides.

INDUSTRIAL MINERALS

Diamond.—Argyle Diamond Mines Pty. Ltd., a joint venture of CRA (56.8%), Ashton Mining Ltd. (38.2%), and the Western Australian government-owned West Australian Diamond Trust (5%), remained the world's leading diamond producer, producing more natural diamond by itself than that produced by any country in the world. Argyle produced more than De Beers Consolidated Mines Ltd.'s 16 wholly and partially owned diamond operations in Botswana, Namibia, and the Republic of South Africa. Argyle accounted for 36% of the world's diamond output in 1987 from its AK-1 kimberlite (lamproite) pipe mine in the Kimberley District. Diamonds from the AK-1 pipe consisted of 6% gem, 39% near gem, and 55% industrial grades, the lowest proportion of gem-quality diamond compared with that from any leading producer country in the world. As a result, although Argyle increased the world's supply of newly mined diamonds by 49%, the value of the world's diamond supply only increased 7%.

Argyle Diamond Sales Ltd. (ADS), jointly owned by Ashton and CRA, continued to market 95% of the joint venture's production. Except for a small quantity of high-quality diamonds retained for cutting and polishing in Western Australia, all of the gem production and 75% of the near-gem and industrial-grade rough diamond was marketed to De Beers' Central Selling Organization, which controlled 80% of the world's supply and marketing of diamonds, in London, England. The balance of near-gem and industrial-grade diamonds was sold by ADS to the international market through its Antwerp, Belgium, office. ADS marketed its gem diamonds through selected jewelers, and the West Australian Diamond Trust marketed its 5% share of production separately.

In August, the Bow River Joint Venture, consisting of Freeport-McMoRan Australia Ltd., 80%, and Gem Exploration and Minerals Ltd., 20%, began constructing a plant 20 kilometers east of the Argyle Diamond Mines' leases for the treatment of diamondiferous alluvium from the Limestone Creek and Bow River area. The plant was expected to become operational in early 1988, processing 4,000 tons of alluvial gravel per day. Diamond production was expected to be 600,000 carats per year, consisting of 18% to 25% gem quality, 65% to 72% near gem, and 8% to 10% industrial-grade diamond.

Freeport-McMoRan, 50%, and Triad Minerals NL, 50%, completed a stream sediment sampling program toward yearend, from which many diamond indicator minerals were recovered, at their Mount Elizabeth diamond project in the east Kimberley District. Mapping has identified two kimberlite-lamproite pipes over the 400-square-kilometer area.

Gem Stones.—Apart from diamond, gem stone mining in Australia consisted principally of opal and sapphire. Small quantities of other gem stones, such as amethyst, chrysoprase, emerald, garnet, nephrite jade, rhodonite, topaz, and zircon, were also produced.

Australia retained its longstanding stature as the world's leading producer of natural sapphire. Australia provided 70% to 80% of the uncut sapphire imported by Thailand, the recognized world leader in the processing and marketing of sapphire in 1987. Sapphire was mined in the Anakie District of central Queensland and in the New England (Inverell-Glen Innes) District of New South Wales.

From 80% to 90% of the world's natural opal was produced in Australia in 1987. Most of Australia's opal was mined from three fields in South Australia: Andamooka, Coober Pedy, and Mintabie, the largest producer. A smaller amount of opal was also produced in central-northern New South Wales at Lightning Ridge, which was also the world's only source of black opal. A newly discovered field about 20 kilometers from Lightning Ridge, the Sheepyard Field, was showing promise for vastly increased production of opal in the future. A small quantity of opal, mostly the boulder opal variety but including other types, was produced in central Queensland where it occurs in a broad zone between Opalton in the north and Yowah in the south, near the

border with New South Wales.

Because most of the sales transactions were conducted privately between miner and buyer, reliable production and trade statistics for opal and sapphire were not available.

MINERAL FUELS

Coal.—For the fifth successive year, production, consumption, and exports of black coal attained record-high levels despite the continuance of massive world oversupply and depressed international prices. The coal industry was Australia's biggest foreign-exchange earner, accounting for more than one-third of export revenues from the minerals sector and 15% of the country's export earnings. It was also the country's largest employer. Raw coal production in Queensland, Australia's largest producing State for the third consecutive year, increased 2% to 85 million tons. New South Wales produced 83.7 million tons for a 4% increase. These two states accounted for more than 96% of the coal production and virtually all of the country's coal exports.

Domestic coal consumption increased 3% to an estimated 44.8 million tons. Approximately 90% of the domestic coal consumption was by the electricity and iron and steel industries, primarily using steaming and coking coals, respectively.

Coal exports again recorded record-high tonnages, increasing 10%. Queensland's coal exports increased 16% accounting for 58% and 59.2 million tons of the total, and exports from New South Wales increased 7%, to 42.8 million tons.

The Commonwealth Scientific and Industrial Research Organization patented a process for making coal that is nearly free of mineral impurities and that can be used as a substitute for heavy fuel oil.

Petroleum and Natural Gas.—Despite its relative self-sufficiency in oil and gas production, which meets 80% to 85% of domestic needs, Australia remained a minor producer in terms of world standards. Unless significant new oilfields are discovered, Australian production can be expected to decline significantly by 1990. Output of crude oil and condensate increased 7% to 200 million barrels, although still below 1985's record-high production level. Production of liquefied petroleum gas declined 1%. Natural gas production increased 2% to 530 billion cubic feet, establishing a new record.

More than 90% of the crude oil continued to come from the Gippsland Shelf fields in the Bass Strait between Victoria and Tasmania. The majority of the remaining production was from the Barrow Island Field off Western Australia and from the Cooper and Eromanga Basins in South Australia and Queensland.

The number of exploration wells drilled onshore, 211, was substantially higher than that of 1986. However, the number of exploration wells drilled offshore, 15, was only one-half the number drilled in 1986. The total number of wells drilled, 282, increased by 60% compared with that of 1986. The number of development wells drilled, 56, increased by 51% although offshore development drilling remained at about the same level as in 1986. Seismic activity included 41,097 line kilometers being shot, of which 24,889 kilometers were offshore.

Uranium.—Production of uranium oxide (U_3O_8) in Australia decreased 9% owing to decreased production at both the Ranger Mine, owned by Energy Resources of Australia Ltd. (ERA), and the stockpiled ore at the Nabarlek operation, owned by Queensland Mines Ltd. (QML). ERA produced 3,103 tons of U_3O_8, a decrease of 11% from that of 1986, and QML produced 1,354 tons of U_3O_8, a 3% decrease. Uranium was Australia's second most valuable energy export.

Although Australia produced 11% of the market economy countries' uranium output in 1987 and was the fourth largest producer behind Canada, the United States, and the Republic of South Africa, the industry was of comparatively little importance to the nation's economy. All uranium was produced for export because Australia had no nuclear powerplants. However, the Government operated a small reactor at Lucas Heights, near Sydney, for research and the production of isotopes and radiopharmaceuticals for medical use.

Underground development of the mine and erection of a metallurgical plant and a flash smelting furnace at the Olympic Dam project at Roxby Downs Station progressed throughout the year. The service decline, the main access to the underground workings, was completed in June. The production of uranium would begin by the target date of October 1, 1988, at the rate of 2,000 tons per year, and this would more than offset the rapidly depleting stocks at the Nabarlek Mine, expected to be exhausted by July 1988. Production was to increase to 3,000 tons per year within 4 years after startup. The mine's owners reported that, as of yearend, they had long-term agree-

ments for the sale of uranium to the Swedish State Power Board, the Central Electricity Generating Board of the United Kingdom, and the Korea Electric Power Corp. The agreements were said to cover 31% of planned production.

CRA Exploration Pty. Ltd. reported that evaluation drilling at the Kintyre prospect, located just inside the northern boundary of the Rudall River National Park in Western Australia, had identified 15,000 tons of probable reserves of U_3O_8 and an additional 17,000 tons of possible U_3O_8 reserves. CRA Exploration was planning to explore the deposit further during 1988.

The Queensland Department of Mines approved the surrender of the mining leases held by Mary Kathleen Uranium Ltd. (MKU) in May and assumed the responsibility for environmental monitoring of the mining site near Mount Isa in June. MKU, owner of one of Australia's initial and most successful uranium mining operations, ceased mining in 1981 when economic reserves were depleted. It has since been concerned with site restoration and cleanup in accordance with environmental regulations and filling outstanding uranium contracts with Europe from stockpiled material. The final contract delivery was made in January 1985.

[1]Physical scientist, Division of International Minerals.
[2]Converted from Australian dollars (A$) to U.S. dollars at the rate of A$1.00=US$0.687 in 1985, and A$1.00=US$0.75 in 1987.

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